DF 15: Dielectric and ferroelectric thin films

Time: Thursday 9:30–11:35 Location: EB 107

Invited Talk DF 15.1 Thu 9:30 EB 107

Dielectric perovskite oxides: Always good for a surprise — •Annette Bussmann-Holder — Max-Planck-Institut für Festkörperforschung, Heisenbergstr. 1, D-70569 Stuttgart, Deutschland

Dielectric perovskite oxides exhibit multiple complex phases which vary from purely displacive to order/disorder driven to precursor dynamics. Four special cases are in the focus of this talk: the cases of $BaTiO_3$, relaxor ferroelectrics, $SrTiO_3$ and its isotope induced ferroelectric state, and finally $EuTiO_3$ and its mixed crystals with $SrTiO_3$. It is shown, that for all these compounds a single model can account for the very different dynamical behaviour and that coexistences and crossovers in the dynamics occur which invalidate categorizing dielectric perovskites.

5 min. break

DF 15.2 Thu 10:15 EB 107

Strain effects in ferroelectric thin films: the impact on the switching kinetics of Pb(Zr,Ti)O_3 — •Andreas Herklotz[1,3], Michael D. Biegalski[2], Hans M. Christen[2], Ludwig Schultz[1], and Kathrin Dörr[3] — [1]IFW Dresden, 01171 Dresden, Germany — [2]Oak Ridge National Laboratory, Center for Nanophase Materials Sciences, 37831 Oak Ridge, TN, USA — [3]Martin-Luther-Universität Halle-Wittenberg, 06099 Halle, Germany

We present first results on the effect of biaxial strain on the switching of ferroelectric thin films. The strain state of epitaxially grown tetragonal and rhombohedral $Pb(Zr,Ti)O_3$ films is controlled directly and reversibly by the use of piezoelectric $Pb(Mg_{1/3}Nb_{2/3})_{0.72}Ti_{0.28}O_3$ (001) (PMN-PT) substrates. The ferroelectric switching behavior is investigated by pulsed electric polarization measurements.

At small external electric fields the films show switching characteristics consistent with a creep-like domain wall motion behavior. In this pinning regime we find a huge decrease of the switching time under compressive strain, i.e an acceleration of the switching kinetics. For larger external electric fields the domain wall motion turns into a depinning regime. The strain effect is changing to a moderate positive value, that is, the switching kinetics is slowed down under the influence of compressive in-plane strain. These results are found in tetragonal and rhombohedral films, thus revealing a general behavior that is not governed by the lattice symmetry or the domain pattern.

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Nonlinear Dielectric Properties and Polarization in Ferroelectric P(VDF-TrFE) Copolymer Thin Films — •Danny von Nordheim, Steffen Hahne, and Bernd Ploss — Department of SciTec, University of Applied Sciences (FH) Jena, Carl-Zeiss-Promenade 2, 07745 Jena, Germany

VDF-TrFE copolymer ferroelectric thin films of molar composition 70/30 have been prepared by spin coating on glass substrate covered with aluminum electrode. Copolymer - solvent composition was varied from 1 wt% to 5 wt% in order to obtain sample thicknesses from 25 nm to 175 nm. Nonlinear permittivities up to ε_3 of poled and unpoled samples have been studied over temperature in heating and cooling cycles up to 120 °C i. e., above the Curie temperature. The polarization and its temperature dependence is derived from first and second order permittivities ε_1 and ε_2. Results offer a non-destructive readout of the polarization state. A non-switchable polarization is found which remains after heating the material above Curie temperature. This non-switchable polarization points from the bottom to the top electrode and is not influenced by the initial polarization direction.

DF 15.4 Thu 10:55 EB 107

Charge storing onto silicondioxide surfaces — •Bjoern Martin, Abhishek Rathi, and Herbert Kliem — Saarland University, Germany

The surface of silicondioxide/silicon structures is charged with the tip of a cantilever in contact mode by application of a voltage. Then, the surface potential is measured contactless using the Kelvin option of an atomic force microscope. On the position of the charged domain a potential difference in relation to the uncharged region is found.

It turns out that the height and the width of this potential difference depend on charging time, charging voltage, sample thickness, and doping of the silicon substrate. SiO_2/n-Si structures with thicknesses of about 10nm to 20nm contacted with negative voltages show the best charging behavior.

Additionally, a transient decay and a transient spread of the surface potential with a time constant of about 10h are observed. This time constant decreases with increasing humidity.

Due to the long-term stability and due to the possibility to reverse the sign of the deposited charges by charging in opposite direction an application of the system as surface charge memory device is thinkable.

It is remarkable and not yet fully understood why positive surface potentials indicating positive charges are found after charging with positive voltages.

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Changes in microstructural and opto-electric properties of CrN films induced by vanadium ion implantation — Mirjana Novakovic[1], Agnes Traverse[2], Maja Popovic[1], Kun Zhang[3], •Klaus-Peter Lieb[3], and Natasha Bibic[1] — [1]VINČA Institute of Nuclear Sciences, 11001 Belgrade, Serbia — [2]Lab. Chimie Physique, Université Paris-Sud, 91405 Orsay, France — [3]II. Physikalisches Institut, Universität Göttingen, 37077 Göttingen, Germany

Transition-metal nitrides are known for their excellent tribological properties, making them important materials for protective hard coatings. In addition, CrN offers interesting thermoelectric and magnetic properties, correlated with a structural and magnetic phase transition at 273-286 K. The presence of additional transition-metals such as V or Mo plays an important role on their properties. We report on modifications of 280 nm CrN layers deposited on Si wafers via reactive sputtering and irradiated at room temperature with up to 2x1017 V-ions/cm2 at 80 keV. Rutherford backscattering spectroscopy (RBS), transmission electron microscopy (XTEM, HRTEM), and X-ray diffraction (XRD) were used to characterize changes in the structural properties. Their optical and electronic features were obtained by infrared spectroscopy in reflection mode and by electrical resistivity measurements. CrN was found to keep its cubic structure under the ion implantation; the initially partially non-metallic CrN layer displays metallic character, which could be related to Cr1-xVxN formation.